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Ancient Monuments Laboratory
Report 8/91

PALYNOLOGICAL ANALYSIS OF BRITISH RAIL SECTIONS AT STANSTED AIRPORT, ESSEX

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Summary

Pollen analysis was carried out on portions of two sections of alluvial deposits which had been exposed by excavations associated with the new rail link serving the airport. The analysis showed that prior to 3350 BP, the site was dominated by mixed woodland with *Alnus* and *Tilia* being important components. There was some indication of minor woodland disturbance at about 3550 BP and after a period of woodland regeneration, more extensive clearance began at about 3350 BP. By about 3000 BP, the site had developed extensive reed swamp and there was evidence for mixed farming. Although Saxon artefacts were exceedly rare at Stansted, pollen analysis showed that the area presented a virtually cleared landscape with local reed swamp and mixed farming in Saxon times.

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INTRODUCTION

In the Spring of 1988, construction work associated with the new rail link serving Stansted Airport revealed sections through alluvial sediments near the Stansted Brook, to the south-west of the Airport complex. Two sections were sampled for macrofossil and pollen analysis. Peter Murphy's report on the macrofossil content of the sediments has included description of the stratigraphy of the sections, and their positions relative to each other, and to the Stansted Brook and M11 Motorway (AM Report 166/88), so detailed stratigraphic information on all the deposits will not be repeated in this pollen report. However, Figure 1 gives a simplified stratigraphy of the two sections, showing their possible sedimentary relationship, as well as two radiocarbon dates on material obtained by Murphy

(After Murphy 1988)

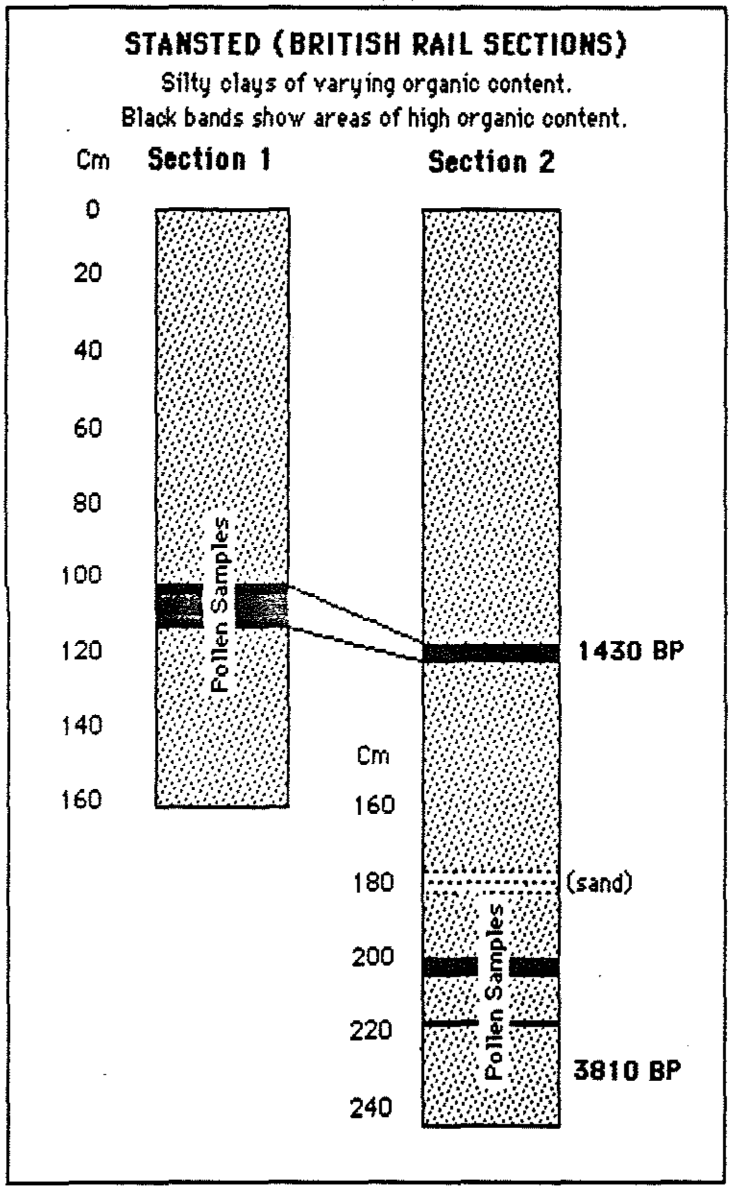

FIGURE 1

The radiocarbon date of the upper densely organic band of Section 2 of 1430 ± 60 BP was obtained on a sample of organic sediment from 117-121 cm while the lower date of 3810 ± 80 BP was obtained on twigs from 228-238 cm. The upper band was, therefore, of Early Saxon date while the lower one was Bronze Age. These two dates allowed an interpolated chronology for the pollen samples although it must be remembered that since the accretion rate of the sediments is not known in detail, the interpolated dates must be viewed with considerable caution.

Radiocarbon dates were not obtained for Section 1 and it was assumed that the organic band from 100-108 cm was equivalent to the upper band in Section 2, its presumed date thus being Early Saxon.

The sediments sampled in this study are of considerable importance to the Project since (a) the earliest evidence for settlement is Late Bronze Age and (b) there was a paucity of evidence for activity in Saxon times (Brooks & Wall 1988). The archaeology suggests that the south-west corner of the project area (Social Club Site - SCS), which had the better soils, was occupied during the Bronze Age, while no occupation sites were found elsewhere for the period. The evidence for Saxon settlement is very tenuous but since Colchester and Bassingbourn Halls are mentioned in the Domesday Book of AD 1086, it is thought that Saxon occupation remains have been destroyed or are yet undiscovered.

METHODS and RESULTS

Sampling and Counting

For Stansted 1, a core of sediments using a Russian Borer was obtained from a depth of 80-130 cm Spot samples were analysed for pollen content and it was found that there was adequate preservation only in the organic band beteen 100-108 cm. Accordingly, contiguous 1 cm samples were analysed from 100-109 cm. For Stansted 2, a monolith of sediments were obtained from 180-225 cm. Spot samples revealed that pollen preservation was much better in this section and samples were analysed at 2 cm intervals throughout the profile.

Samples were subjected to standard acetolysis and hydrofluoric acid treatment (Dimbleby 1985), stained with aqueous safranine and mounted in glycerol jelly. In Stansted 1 an average of 350 pollen grains were counted in each sample. However, in Stansted 2, there was insufficient time for counting of pollen grains and it was decided that detailed counts would be carried out at a later date in a wider scheme of work. In the meantime, each sample was scanned (twenty transects per slide) and the presence of all encountered taxa was recorded.

Representation of Data

Stansted 1: In view of the nature of the data, it was decided not to employ the use of standard pollen diagrams since a series of summary diagrams gave more pertinent information. Pollen diagrams were constructed from ecological groups as well as from selected individual taxa (Figures 4-7). Detailed pollen percentages for individual taxa are shown in Tables 3 and 4. Because of the overwhelming over-abundance of swamp taxa and Gramineae (grasses), both were omitted from the pollen sum for percentage calculation. This means that all other taxa were attributed exaggerated values but this was stressed wherever it was important. Swamp taxa and grasses were expressed as percentages of total pollen and spores (TP)

An idea of variation in species richness throughout the sediments was given by a simple species richness index (SRI) calculated as follows:

$$SRI = \frac{\text{No of Taxa in a Sample}}{\text{Total Taxa}} \times 100$$

Stansted 2: Because pollen was not counted in the Stansted 2 samples, pollen diagrams were not constructed, and details of pollen findings are shown in Tables 1 and 2. However, it was possible to construct a species richness index as above and this is shown in Figure 3.

Results

Results are shown on Tables 1-4 and Figures 1-7. These are incorporated into text as appropriate

DISCUSSION

STANSTED 2

Murphy carried out macrofossil analysis on deposits from 90-230 cm, thus including the organic bands shown in Figure 1. He found that identifiable material was scanty, and preservation exceedingly poor, so that his interpretation was somewhat limited. The monolith collected for pollen analysis covered from 180-225 cm and pollen was much better preserved than the macrofossil material. Although only a scan was achieved, a considerable amount of information has been obtained regarding vegetation changes during the period represented by the sediments and when the two radiocarbon dates are plotted against depth, a tentative chronology is achieved for vegetation history for the period. However, it must be remembered that, with only two dates available, the interpolated dates must be viewed with caution since accretion of sediments in river valleys of this type is most unlikely to have occurred at a constant rate.

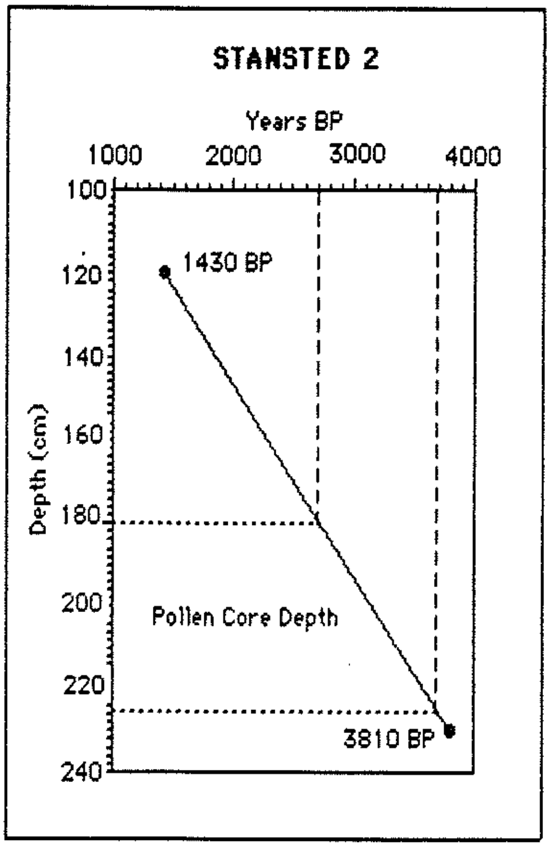

FIGURE 2

It can be seen from Figure 2 that the depth of sediments represented by the pollen core may be estimated to cover from about 3650 BP to approximately 2700 BP, a period of 950 years during the Bronze Age. Tables 1 and 2 and Figure 3 shows that at 3650 BP the area was dominated by mixed woodland with *Tilia* (lime) and *Alnus* (alder) being a prominent components. The ground in the immediate locality must have been moderately damp for the pollen to be preserved but there is no evidence of swampy conditions. At about 3550 BP (depth 220 cm), the number of pollen taxa increased markedly and plants typical of damp conditions, and even standing water, such as Cyperaceae (sedges), *Potamogeton* (pondweed) and *Sparganium* type (bur-reed) were recorded.

The increase in species richness at this level could be due to one of several reasons. Firstly, the increase could have been due to an opening of the tree canopy so that pollen of trees and shrubs growing further afield could find its way into the sediments. The opening canopy would also allow the spread of ground cover plants such as *Plantago* (plantain) and Liguliflorae (c.f. dandelion). This opening of the canopy could, of course, have been brought about by the activities of Bronze Age peoples and, indeed, since charcoal was found in every sample, there is little doubt that people were active in the area. Secondly, the increased wetness might have improved conditions for pollen preservation so that a wider spectrum was found and, lastly, there could have been water flowing into the channel, bringing pollen from outside the immediate catchment.

In any event at about 3500 BP (218 cm) the deposit became very much more organic and only two pollen grains were found. It is obvious that conditions prevailing at this time favoured the decomposition of organic remains. It is possible that the ground became much drier and aerobic (even if periodically) so that microbial activity would have been high and sub-fossil material would fail to be preserved.

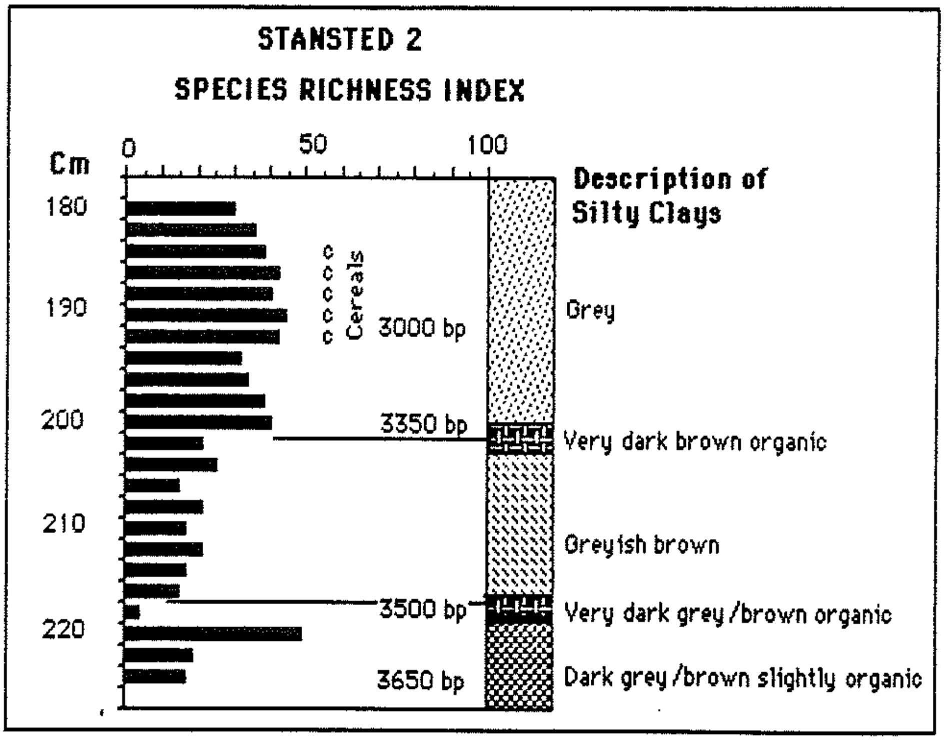

FIGURE 3

In the period from about 3500 BP to 3350 BP (218-202 cm) pollen preservation was good, indicating a higher water table once more, and lime/alder-dominated woodland formed the major part of the vegetation with herbaceous plants being a minor component.

The organic band between 205-202 cm might indicate another period of conditions favouring decomposition since Murphy found only a very poor assemblage of macrofossils which was dominated by badly degraded nutlets of *Urtica dioica* (stinging nettle). However, conditions must have allowed preservation of pollen and, therefore, were not comparable with those prevailing in the lower organic band. It is very interesting indeed that no pollen of stinging nettle was found in these deposits in spite of the prevalence its macrofossil remains. Mixed woodland remained the dominant vegetation but an opening of the canopy is indicated by the finding of plantain, c.f. dandelion and grass pollen.

The junction between the top of the organic band and the overlying grey silty clay was very sharp and there were obvious changes in the pollen spectrum. It can be seen from Figure 3 that species richness noticeably increased and herbs of open habitat increased in frequency. It is also noteworthy that pollen of lime declined and, although Tables 1 and 2 give no quantitative data, scanning of the pollen slides showed that tree pollen as a whole was less abundant than before.

The decline of lime in Britain seems to be a diachronous event, occurring as early as the latter part of the Neolithic period in some areas such as the Isle of Wight (Scaife 1980), and as late as Saxon in Epping Forest (Baker et al 1978). However, most radiocarbon dates for lime decline fall within the Bronze Age and Early Iron Age. The phenomenon is generally regarded to be associated with anthropogenic forest clearance rather than climatic events because of its lack synchroneity and its frequent association with an increase in herbaceous pollen including that of cultigens

It appears, therefore, that from about 3350 BP, woodland was declining and open areas were being created, possibly because Bronze Age people were felling trees and pursuing a pastoral economy. It is also important to note that the locality was probably becoming wetter since sedges, pondweed and bur-reed were recorded; the increased wetness might have been due to run-off as a consequence of woodland clearance.

From 3000 BP (between samples 195 and 194 cm) the water table at the site was very high with sedges, bur-reed, *Typha latifolia* (bulrush), *Filipendula* (meadowsweet) and *Salix* (willow) being found in every sample. Tree pollen was less abundant and weedy grassland appeared to be the dominant vegetation, and it is important to note that cereal pollen was also found between 192-184 cm. It is probable, therefore, that for the 300 years represented by samples from 194-180 cm, woodland clearance was more intense and both pastoral and arable farming were being carried out in the area.

STANSTED 1

Based on stratigraphic evidence, the organic band in Stansted 1 between 100-108 cm was deemed to be equivalent to the upper organic band in the Stansted 2 core which gave a radiocarbon date of 1430 BP $\pm$ 60 This means that the deposits were laid down in Saxon times, a period which had yielded little archaeological evidence at Stansted.

Unfortunately, pollen preservation in the sediments underlying and overlying the organic band was too poor for analysis, and detailed results are only available for the organic band between

100-108 cm. Tables 3 and 4 give details of pollen percentages of individual taxa but Figure 4 gives a summary of the major components of the vegetation throughout the period represented by the organic band.

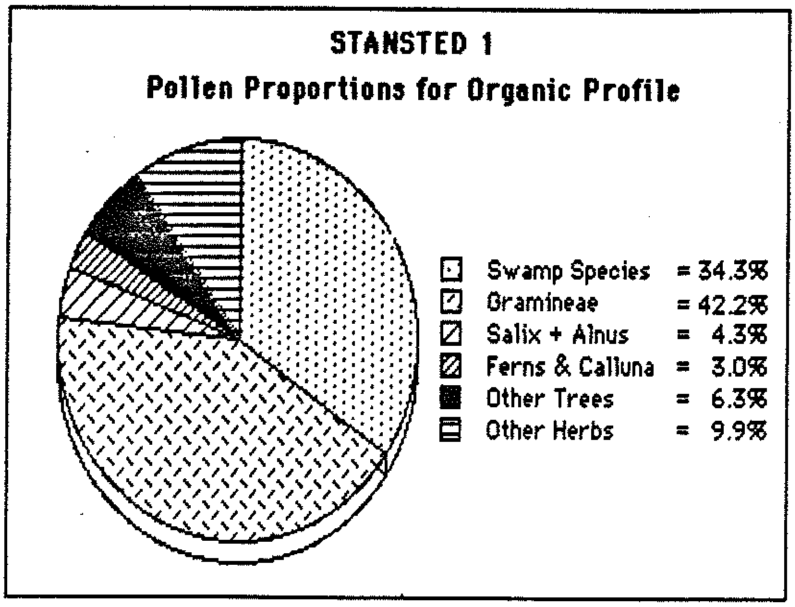

FIGURE 4

The pieplot shows that the total percentage of tree pollen was 10.6%, including *Salix* and *Alnus* (alder), which were likely to have been local, and this low percentage might indicate a very open landscape at Stansted in Saxon times. It is very difficult to assess just what constitutes an open landscape from pollen data but work of Heim (1962) would suggest that if the proportion of tree pollen in a diagram falls below 50%, the landscape is fairly open, and for closed woodland, tree pollen can vary between 64-92% On the other hand, Smith and Taylor (1969) have shown that percentages of 20% indicate wooded conditions in the vicinity of the site, with 5% indicative of (in the case of Smith & Taylor) open moorland vegetation. Work of the author (unpublished) carried out in the same region of Wales as that of Smith & Taylor, refutes their findings, she has shown that a background of 25% tree pollen prevails in the uplands of central Wales where some valley slopes are wooded but plateaux for many hundreds of hectares are completely bare of trees.

It is probably safe to assume that the Saxon landscape at Stansted was an open one but inspection of Table 3 would indicate that what little woodland there was away from the immediate site was dominated by *Quercus* (oak). It must be remembered, however, that there may have been virtually no woodland as such but that the tree/shrub pollen record represents input from isolated trees and patches of scrub.

Murphy (1988) showed from macrofossil evidence that the organic deposits were laid down in a bulrush reedswamp and the pollen record supports his findings. Table 3 and Figure 4 show that swamp species and grasses made up 76.5% of the total pollen spectrum. It is impossible to distinguish between the pollen of reedswamp grasses such as *Phragmites* (common reed) and those which grow in drier grassland so the high grass pollen levels are difficult to interpret.

However, the common reed is usually to be found in the kind of environment which was prevailing in the period under review, and it may be assumed that much of the grass pollen was derived from the swamp itself. Figure 5 shows the relationship between the Species Richness Index and the frequency of swamp species (see Table 3 for taxa included in swamp curve).

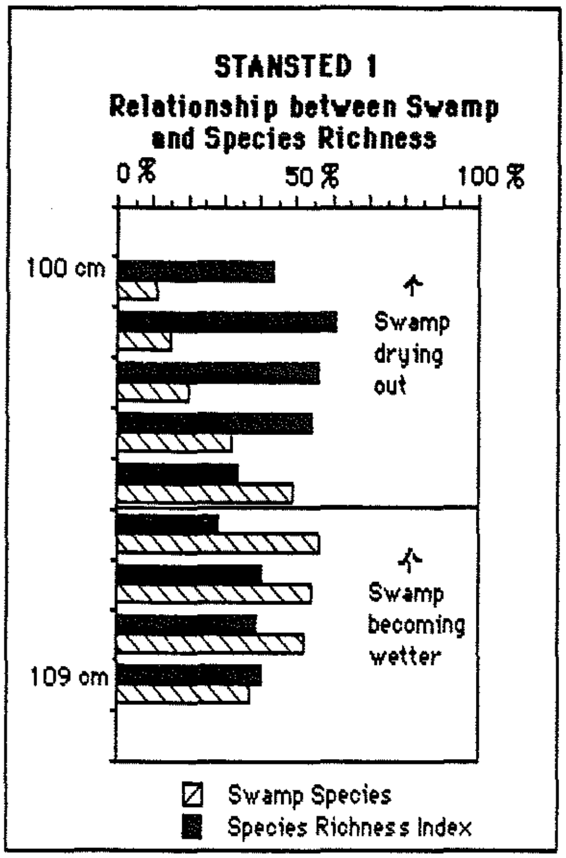

FIGURE 5

The pollen evidence suggest that the site became progressively wetter, accompanied by expansion of the swamp, and then a point was reached when the water table seems to have been lowered and the swamp declined. As the site became drier so species richness increased and the nature of the *in situ* vegetation changed to some degree, the swamp community changing from one dominated by bur-reed, bulrush, sedges and *Apium* type (c.f. water parsnip) to one where, for example, the following were well represented: meadowsweet, Cruciferae (c.f. lady's smock), *Caltha* type (c.f. kingcup), *Chrysosplenium* (golden saxifrage), *Iris*, and *Trollius* (globe flower). Many of the latter group are small, low-growing plants which may have been able to thrive on the muddy surface and margins as the swamp gradually filled-in.

Interpreting the change in species richness is slightly problematical since it might simply be reflecting the density of the swamp rather than a real increase in the number of species growing in the locality. It is well known that tall herb vegetation (especially if meadowsweet is abundant) effectively filters out extra-local pollen (Vuorela 1973) so that the extra-local vegetation (outside the immediate swampy area) might be being recorded more accurately as the swamp declined. On the other hand, Figure 6 might indicate that the filtering effects were relatively small; this diagram shows the relationship of alder and willow and of trees and shrubs (other than alder and willow) in relation to the swamp vegetation.

The pollen curve for trees (other than alder and willow) shows no obvious correlation with the curve for swamp species. On the other hand, alder shows a positive and willow shows a negative relationship with the swamp.

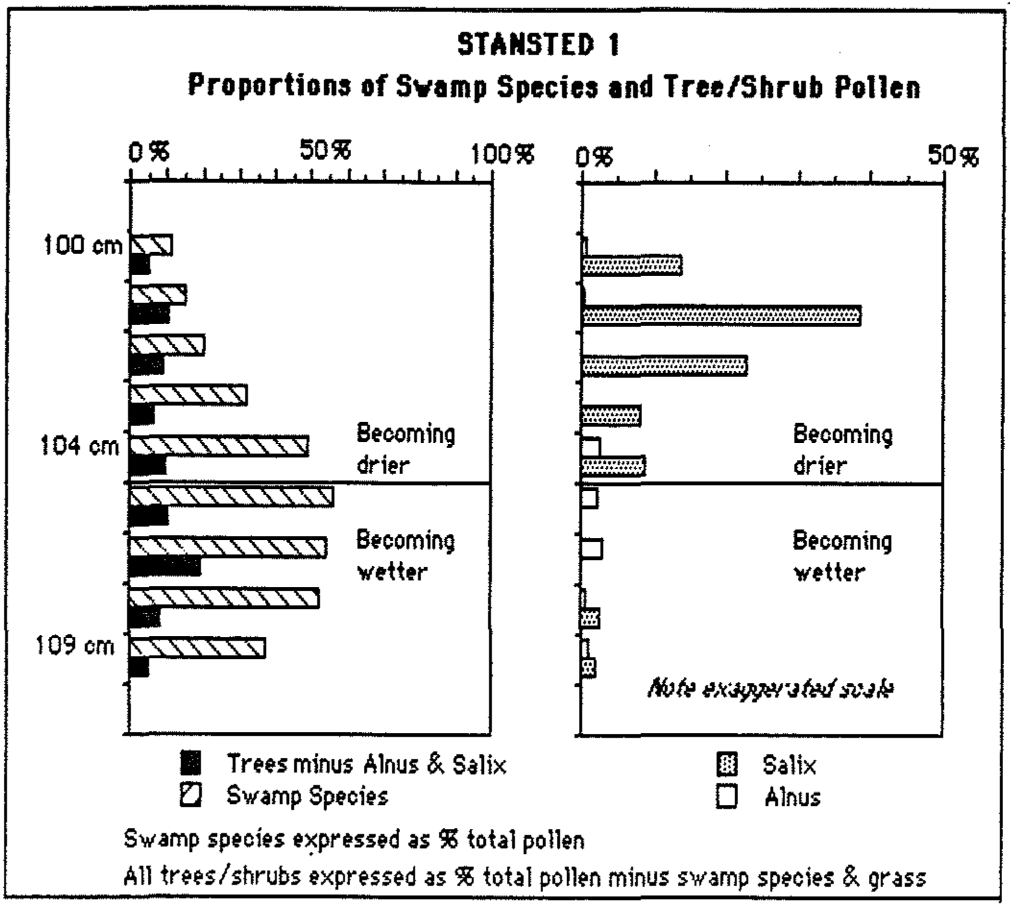

FIGURE 6

In spite of the paucity of its pollen, alder was more abundant during the wetter phase whilst willow became dominant as the swamp dried out. Alder normally produces copious amounts of pollen and the low amounts in this diagram probably indicate that either it was being pollarded, or that very few trees indeed were in the vicinity. Willow, on the other hand, is insect pollinated and only small amounts are normally released to the air so that the large amounts found at this site means that it became exceedingly abundant as the swamp dried out.

The lack of correlation of the other trees with the swamp probably reflects their regional rather than local distribution and the comparative lack in variation in their percentages probably also indicates that the tall herb vegetation of the swamp did not filter out the regional and extra-local pollen to any great extent.

Figure 7 and Table 4 add further evidence to support this hypothesis since 'dry land' herbs such as plantain were well represented even when the swamp was at its height of development. This means, therefore, that the increase in species richness as the swamp dried out was real rather than apparent and was due to an increase in 'dry land' herbs as well as to those exploiting the margins of the diminishing swamp.

Figure 7 shows that grass pollen was high throughout the period under review. As has already been discussed, it is impossible to separate reed pollen from that of pasture grasses but the relative abundance of pastoral herbs and ruderals suggest that pastoral farming was probably

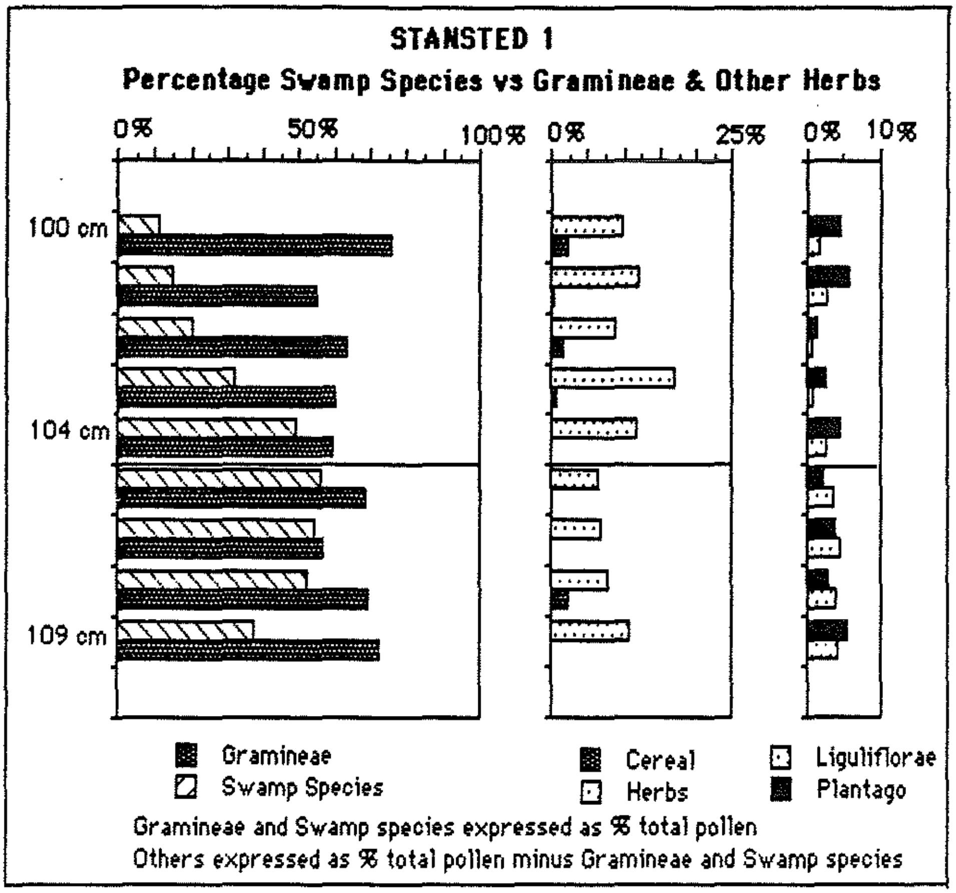

FIGURE 7

an important feature of the local Saxon economy. Arable farming also seems to have been carried out since cereal pollen was found at 108 cm and consistently in the upper levels of the profile. Apart from the pollen of *Secale* (rye), that of cereals is thought to travel only a few metres or even centimetres from a growing crop, although crop processing does disseminate it further afield Vuorela (1973). In any event, the presence of cereal pollen may be taken to indicate the close proximity of a crop, or place of processing.

The relative abundance at the base of the diagram of herbs commonly found in weedy grassland and pasture, and the presence of cereals, indicates that the local landscape was extensively managed in Saxon times. The pollen evidence might thus support Murphy's contention that extensive deforestation for agriculture and settlement caused increased run-off and a raising of local water table with consequent swamp development.

CONCLUSION

On the whole, pollen seems to have been better preserved than macrofossils in these sections of deposits.

Bronze Age: The two radiocarbon dates obtained for the Stansted 2 core indicated that the monolith of sediments analysed for pollen covered about 950 years of the Bronze Age, and the dates allowed a tentative chronology for vegetation history during this time.

At about 3650 BP the site seems to have been enclosed by mixed woodland with lime and alder forming a significant proportion of the tree canopy, and ferns and grasses forming the understory. At about a hundred years later, the site became wet enough to allow the invasion of swamp and this was associated with a marked increase in species richness. These changes may have been due to woodland clearance by Bronze Age people. However, immediately after this period, the site seems to have dried out considerably and lime/alder-dominated woodland prevailed once more.

At about 3350 BP, two hundred years after the first possible interference with the woodland, the area became disturbed again, and to a much greater extent. Woodland declined, lime lost its previous high status, and the site became colonised by reed-swamp. An increase in species richness accompanied these changes and weedy pasture/grassland seems to have spread locally even though trees and shrubs were abundant. The opening up of the tree canopy and spread of open habitat seems to have intensified from about 3000 BP and arable farming soon followed. The former woodland seems to have been largely replaced by reed-swamp with willow becoming important immediately locally.

Saxon: The landscape was very open by 1430 BP and the site was dominated by reed-swamp and weedy grassland/pasture although some arable agriculture was being carried out. Early on, some alder was associated with the swamp, although its low pollen frequencies suggest that it was either being pollarded or that there were very few individuals.

The water table gradually rose and the swamp expanded to a maximum and then declined. The pollen spectra suggest that its decline was due to drying out of the swamp surface and this, of course, may have been due to its filling in through the excessive inwash of silty material from disturbed soils in the surrounding catchment. As the swamp dried out so the species richness of local vegetation increased, partly because of the invasion of low-growing swamp edge species and partly because of those of weedy grassland. Willow invaded the site and replaced alder locally at a time when cereal growing became inceasingly important in the area.

The pollen evidence would suggest, therefore, that Bronze Age people were actively engaged in pastoral and arable agriculture in the environs of the site and that, in spite of the lack of Saxon artefacts, Saxon peoples were also actively engaged in mixed agriculture locally.

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STANSTED 2

Depth (cm)	180	182	184	186	188	190	192	194	196	198	200	202	204	206	208	210	212	214	216	218	220	222	224
Stratigraphy (all silty clay)																							
Grey	+	+	+	+	+	+	+	+	+	+	+												
Very Dark Grey/Brown Organic												+	+										
Greyish Brown														+	+	+	+	+	+				
Very Dark Grey/Brown Organic																				+			
Dark Grey/Brown Slightly Organic																					+	+	+
Trees & Shrubs																							
Alnus	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Coryloid	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+	N	+	+	+
Quercus		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	O	+	+	+
Tilia						+	+		+	+		+	+	+	+	+	+	+	+		+	+	+
Betula					+							+	+					+		O	+		
Pinus		+	+		+		+			+	+	+			+	+	+		+	T	+	+	
Prunus type																				H	+		
Ulmus			+					+	+	+										E	+	+	
Fraxinus			+								+									R			
Salix	+	+	+	+	+	+	+				+		+								+		
Ferns & Sphagnum																							
Polypodium					+				+	+	+	+	+	+	+	+	+	+	+			+	+
Filicales	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Pteridium	+	+	+	+	+	+	+	+	+	+	+		+	+	+		+	+			+		
Sphagnum				+													+			P			
Wetland Plants																				L			
Cyperaceae	+	+	+	+	+	+	+	+			+									L	+		
Filipendula	+	+			+	+		+												E			
Potamogeton											+									N	+		
Sparganium type	+	+	+	+	+	+	+	+		+	+				+						+		
Typha latifolia	+	+	+	+	+		+									+							
Arable Indicator																							
Cereal type			+	+	+	+	+																

[shaded] = Organic Band (cells at 202–204 cm, and at 218 cm, are shaded as organic band)

TABLE 1

STANSTED 2

Depth (cm)	180	182	184	186	188	190	192	194	196	198	200	202	204	206	208	210	212	214	216	218	220	222	224
Stratigraphy (all silty clay)																							
Grey	+	+	+	+	+	+	+	+	+	+	+												
Very Dark Grey/Brown Organic												+	+										
Greyish Brown														+	+	+	+	+	+				
Very Dark Grey/Brown Organic																				+			
Dark Grey/Brown Slightly Organic																					+	+	+
Herbs																							
Artemisia											+												
Anthemis type	+									+													
Aster type						+														N			
Bidens type	+					+					+									O			
Capsella type					+	+	+	+									+						
Caryophyllaceae		+		+			+	+												H			
Centaurea nigra type			+	+																E			
Centaurium		+																		R			
Chenopodiaceae					+				+								+			B	+		
Cirsium				+		+																	
Cruciferae undiff		+		+																P			
Galium type			+	+			+													O	+		+
Gramineae	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+					L	+	+	+
Leguminosae						+		+			+									L			
Liguliflorae	+	+	+	+	+	+	+	+	+	+	+		+				+			E	+		
Mercurialis										+										N			
Plantago lanceolata	+	+	+	+	+	+	+	+	+	+	+		+								+		
Polygonum persicaria										+													
Polygonum undiff																					+		
Poterium																					+		
Ranunculus type							+				+										+		
Rhinanthus type									+														
Rosaceae									+														
Succisa										+													
Trifolium type							+		+														
Umbelliferae				+		+			+	+											+		
Urtica type						+												+					

[shaded] = Organic Band

TABLE 2

STANSTED 1

Depth (cm)	100	101	102	103	104	105	106	107	108
Trees & Shrubs									
Quercus	8.2	16	17	11	20	23	14	20	9.4
Betula	1.4	2.8	1	1.6	4.4	2.3	11	2.5	
Salix	14	39	23	8.1	8.9			2.5	1.9
Corylus	8.2	2.8	4.8	3.2		2.3	16	2.5	5.7
Ulmus	1.4	0.7							
Tilia									1.9
Pinus	2.7	0.7	1.9			4.7	3.6	2.5	
Alnus	2.7	0.7			6.7	7	7.1	2.5	3.8
Ericales									
Calluna			1						
Ferns									
Pteridium	12	4.2	9.5	8.1		14	11	7.5	15
Polypodium	2.7		1	1.6					
Filicales	1.4	1.4	10	3.2	2.2		3.6	7.5	
Swamp Species									
Sparganium type	2.4	5.4	3.9	8.7	18	26	23	32	14
Typha latifolia	0.3	0.3		0.4	2.3	3.3	0.7	2.9	1.3
Cyperaceae	5.9	2.7	8.3	15	24	24	26	12	18
Apium type		0.3	0.3		1.4	0.7	1.4	3.7	2.3
Mentha type		0.5	1.1				0.7	0.4	0.6
Sphagnum							0.4		0.3
Polygonum amphibium									0.3
Cruciferae cf Cardamine	0.6	1.6	0.6	0.4	0.5			0.7	
Filipendula	0.6	2.2	2.5	2.2			0.4	1.1	
Myriophyllum alterniflorum							0.4		
Potamogeton			1.1	3.5	3.2	1.3	1.4		
Caltha type	0.3	0.5	0.6	0.4					
Chrysosplenium		0.3	0.3	0.4					
Iris	0.3	0.5	0.6	0.4					
Trollius			1.1	0.4					
Berula type	0.3	0.3							
Oenanthe type		0.3							
Grass									
Gramineae	68	47	51	41	30	30	26	33	45

Taxa expressed as percentage total pollen minus swamp species and grasses
Swamp species and grasses expressed as percentage total pollen

TABLE 3

STANSTED 1

Depth (cm)	100	101	102	103	104	105	106	107	108
'Dry Land' Herbs									
Cereal	9.6	0.7	4.8	1.6				7.5	
Plantago lanceolata	19	13	3.8	6.5	11	7	8.9	10	5.7
Liguliflorae	6.8	5.6	1.9	1.6	6.7	12	11	13	4.1
Bidens type	4.1	2.8	4.8	4.8	6.7	2.3		5	0.5
Caryophyllaceae	1.4		1.9	1.6	2.2				0.5
Rumex acetosa		0.7	3.8	1.6					1
Urtica type									1
Hypericum perforatum type									1
Pimpinella type									0.5
Sinapis type		1.4	1						0.5
Trifolium type		0.7							2.1
Rumex undiff	1.4	0.7		16	24	12	3.6	7.5	
Chenopodiaceae		0.7		1.6				2.5	
Anthemis type		0.7	1.9	4.8				7.5	
Heracleum type	1.4						3.6		
Ranunculus type		0.7	1.9			4.7	1.8		
Cruciferae undiff						2.3	1.8		
Lotus type							3.6		
Rumex obtusifolius type	1.4		1.9	13	2.2	4.7			
Cirsium						2.3			
Artemisia					2.2				
Capsella type					2.2				
Galium type		2.8		4.8					
Stachys type		0.7	1	1.6					
Potentilla type				1.6					
Rubus				1.6					
Digitalis type			1						
Reseda			1						
Rhinanthus type		0.7							
Pollen expressed as percentage total pollen minus swamp species and grasses									

TABLE 4